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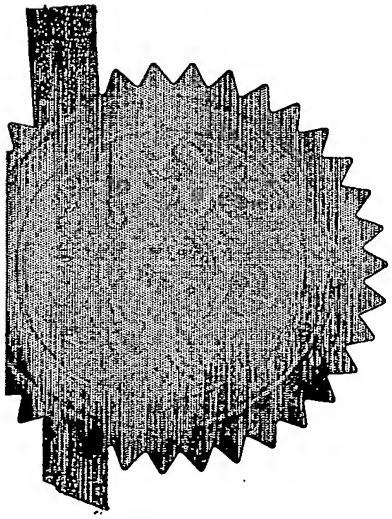

Signed M Cooke

Dated 4 July 2003

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10JUN02 E724361-1 D10059
P01/7700 0.00-0213166.2

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP9 1RH

1. Your reference
LRD-GB-1-414

2. Patent application number
(The Patent Office will fill in this part)
0213166.2

10 JUN 2002

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
K.U.Leuven Research and Development - Groot Begijnhof 59 - 3000 Leuven

Represented by Dr. Ivo Roelants, IPR Officer

Patents ADP number *(if you know it)* 77909750002

If the applicant is a corporate body, give the country/state of its incorporation
Belgium

4. Title of the invention
Monolithic cutting tool

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

K.U.Leuven R&D
care off:
Hubert Velge
Neaves Cottage
Neaves Lane - Glyndebourne
East Sussex BN8 5UA

Patents ADP number *(if you know it)* 80491650002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	2
Claim(s)	1
Abstract	1
Drawing(s)	4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	1
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	1 fax cover sheet 1 fee sheet with request for fax back service

11. I/We request the grant of a patent on the basis of this application.

Dr. Ivo Roelants - IPR Officer — Signature — Date 09.06.02

12. Name and daytime telephone number of person to contact in the United Kingdom

Hubert Velge
+44 7940 540 397

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Notes

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c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

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A monolithic cutting tool

Backgound

Because of the ongoing miniaturisation, precision mechanics is becoming more and more important and this requires very high precision tools. High speed cutting is one of the best ways to get a very high precision. Another advantage of very high speed cutting is the fact that from a certain speed cutting forces and temperatures decrease as stated by Salomon in his Salomon curves. A last advantage of very high speed cutting is that there is no need for using cutting fluids which makes very high speed cutting environmentally attractive. With environmental legislation becoming more and more severe high speed cutting becomes more and more attractive.

The disadvantage of high speed cutting is that high speed machines are more difficult to build. This invention contributes to the construction of high speed and high precision rotating machines.

The best way to build a high speed and high precision cutting tool like a grinding wheel is to make it monolithic with its shaft. The problem with this is that with the classical bearing systems replacing the cutting tool becomes very difficult. This makes it impossible to implement high speed cutting with a monolithic cutting tool in an industrial environment where tool replacements are executed regularly. With this new bearing system which uses the sides of the cutting tool as a countersurface for the bearing it is possible to use the advantages of a monolithic cutting tool on an industrial scale because it is easy to change the cutting tool and it was proven with a prototype that after exchanging the cutting tool the machine is as accurate as before.

Summary of the invention

The invention provides an enhanced fluid film bearing system for high speed cutting tools. The new bearing system allows higher precision and higher speeds combined with fast tool changing. The high precision and higher attainable speeds are the result of the fact that both journal and thrust bearing are placed close to the cutting tool which results in a very stiff construction and of the fact that the cutting tool is monolithic with it's shaft. The fast tool changing is made possible by having one end of the bearing system removable. After this the whole axis with the cutting tool can be removed. This is only possible because the sides of the cutting tool are used as a thrust bearing surface. With a normal thrust bearing it is impossible to change tools easily.

Brief description of the drawings

Fig. 1 is a cross-sectional view of an embodiment of a grinding wheel according to the present invention. The application is grinding. Motor and shaft-grinding wheel are on different axes.

Fig. 2 is a detail of figure 1 illustrating the present invention.

Fig. 3 is a view of the monolithic tool-shaft illustrating the thrust bearing surfaces on the sides of the cutting tool.

Fig. 4 is a cross-sectional view of an embodiment of a grinding wheel according to the present invention. The application is grinding. Motor and shaft-grinding wheel are on the same axis.

Description of the preferred embodiment

Fig. 1 illustrates an embodiment of the invention as it was build by the inventors at the K.U. Leuven. It is a high speed grinding spindle with a motor on a separate axis. The grinding wheel 1 is monolithic with its shaft. The motor 2 is mounted on a separate axis. The two axes are joined with a coupling 3 that allows easy mounting and dismounting.

Fig. 2 illustrates better the bearing system. In this embodiment it is a gas bearing. The tool 1 , in this embodiment a grinding wheel, is supported by a fixed thrust and journal bearing 2 at one side and a removable thrust bearing 3 and journal bearing 4 at the other side of the cutting tool. The thrust bearings 2 and 3 use the sides of the monolithic tool-shaft 1 as a bearing surface. The thrust-and-journal bearing 2 is fixed in the housing 5. The thrust bearing 3 and the journal bearing 4 are mounted in the cover 6 with bolts 9. The cover 6 together with bearings 3 and 4 can be dismounted from the housing 5. Then the monlithic wheel-shaft 1 can be dismounted. A new axis unit can be mounted and the cover 6 together with bearings 3 and 4 is mounted again. Guiding Dowel pins 7 ensure that the cover 6 and radial bearing 4 are replaced in the exact same radial position as before. The springs 8 position bearing 3 and set the thrust bearing force by turning bolts 10.

With this construction we have a very high precision bearing system that can be easily dismounted for tool revision/up hauling.

Fig. 3 Shows in detail the monolithic shaft-tool combination of Fig's 1 and 2. It shows the journal and thrust bearing surfaces. The journal bearing surfaces are on both sides of the cutting tool, the thrust bearing surfaces are located on the faces of the cutting tool.

Fig. 4 shows another embodiment of the invention. In Fig. 4 the rotor of the motor 1 is mounted on the same axis 2 as the cutting tool. This makes a very compact construction possible and overcomes possible problems with the coupling. The bearings used are one fixed journal thrust bearing combination 3 at the left side and at the right side one floating thrust bearing 4 combined with a journal bearing 5. Bearings 4 and 5 are fixed in the cover 6. The tool change is done in the same way as in the first embodiment.

We claim:

1. A bearing system that uses fluid bearings (gas or liquid) for high precision and high speed cutting tools. The cutting tool is monolithic with the shaft. This bearing system is a combined journal and thrust bearing system. The thrust bearing uses the sides of the cutting tool as a bearing surface. The tool is placed between to two bearings.
2. The bearing system of claim **1** driven by a motor mounted on a different axis.
3. The bearing system of claim **1** driven by a motor mounted on the same axis.
4. The bearing system of claim **1** used in different applications than cutting tools.
5. The bearing system of claim **1** to **4** used with a combination of self acting and externally fed fluid film bearings.

A monolithic cutting tool

Abstract

A fluid film bearing system for rotating cutting tools which allows very high precision, very high speeds and an easy change of the cutting tool. The fluid film bearing system can be a liquid or a gas bearing system. The fluid film bearing system includes two journal bearings on both sides of the cutting tool and two thrust bearings which use the faces of the cutting tool as bearing surfaces. The cutting tool is monolithic with the shaft on which it is mounted. One of the thrust bearings is suspended by a spring to allow thermal deformation. One side of the bearing system can be removed for easy tooling change. The other side is fixed. Having the cutting tool between the two bearings gives very little deflection and results in very high precision. Using the sides of the cutting tool as a thrust bearing counter-surface makes it possible to change the cutting tool easily and rapidly. The cutting tool is driven by an engine that can be mounted on a separate or on the same axis as the cutting tool. If the engine is mounted on a separate shaft there is a coupling between the two shafts which allows easy replacement of the cutting tool shaft. If the engine is mounted on the same shaft as the cutting tool the engine has to be small enough to go through the cutting tool. The rotor of the engine is then replaced together with the cutting tool.

FIG. 1

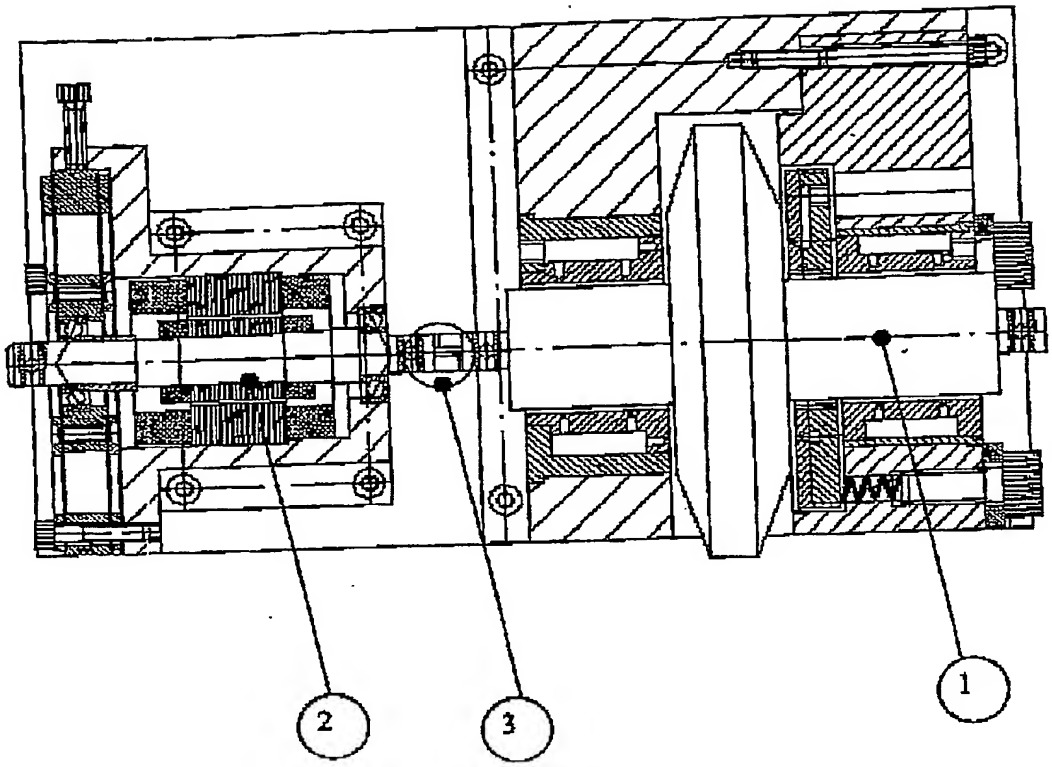

FIG. 2

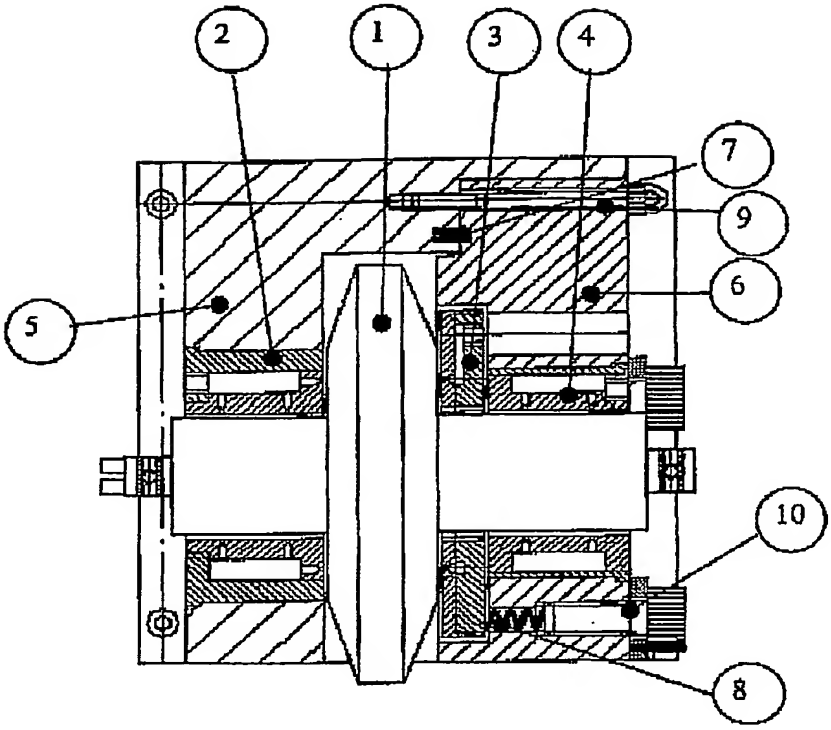

FIG. 3

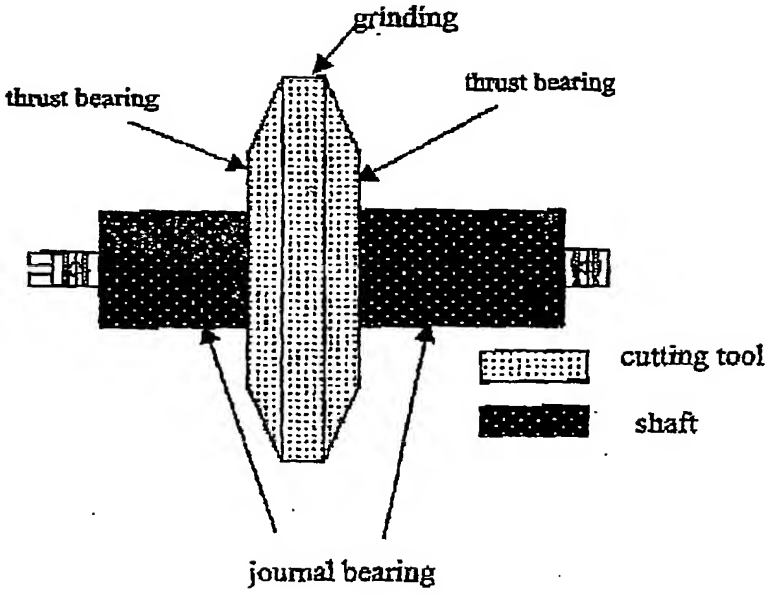

FIG. 4